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LANL Sustainability Program

Smart Labs @ Los Alamos National Laboratory

Monica Witt, Program Manager

January, 2019

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NNSA National Nuclear Security Administration

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This briefing contains…

- Smart Lab Program Overview
- Why Smart Labs @ LANL
- How Smart Labs @ LANL
- Program Accomplishments
- Metrics
- Future Projects

Smart Labs Program Overview

Smart Labs are:

1. Laboratories that operate at the highest level of safety and energy performance.

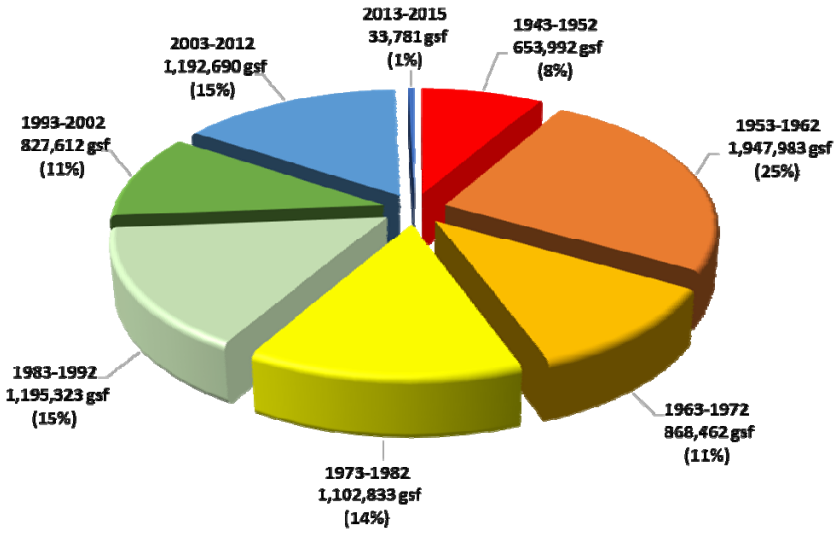
2. Laboratories that use a building-specific data stream to continuously monitor and adjust facility conditions.

Smart Labs should be:

1. Effective
2. Safe
3. Efficient
4. Sustainable

LANL thought we could have safer and more efficient buildings…we should develop a Smart Lab Program.

We have old, inefficient buildings and over 700 fume hoods!



UC Irvine set the example

- Wendell Brase is the University of California, Irvine's first Associate Chancellor for Sustainability. Brase co-chairs the University of California's Global Climate Leadership Council and chairs UC's Energy Services Governing Board.
- For 25 years, he provided leadership for an award-winning sustainability program in his role as Vice Chancellor for Administrative and Business Services.

- Marc Gomez is the Assistant Vice Chancellor for Facilities Management and Environmental Health & Safety at the University of California, Irvine. He has a Master of Public Health degree from the University of Michigan and a Bachelor of Science degree from Tulane University.
- Marc has served in many leadership positions for the Campus Safety, Health and Environmental Management Association as well as the American Industrial Hygiene Association.

- Matt Gudorf is the Assistant Director of Engineering, Energy, and Inspection at UC Irvine.
- He was named the 2012 Energy Engineer of the Year by the Association of Energy Engineers.

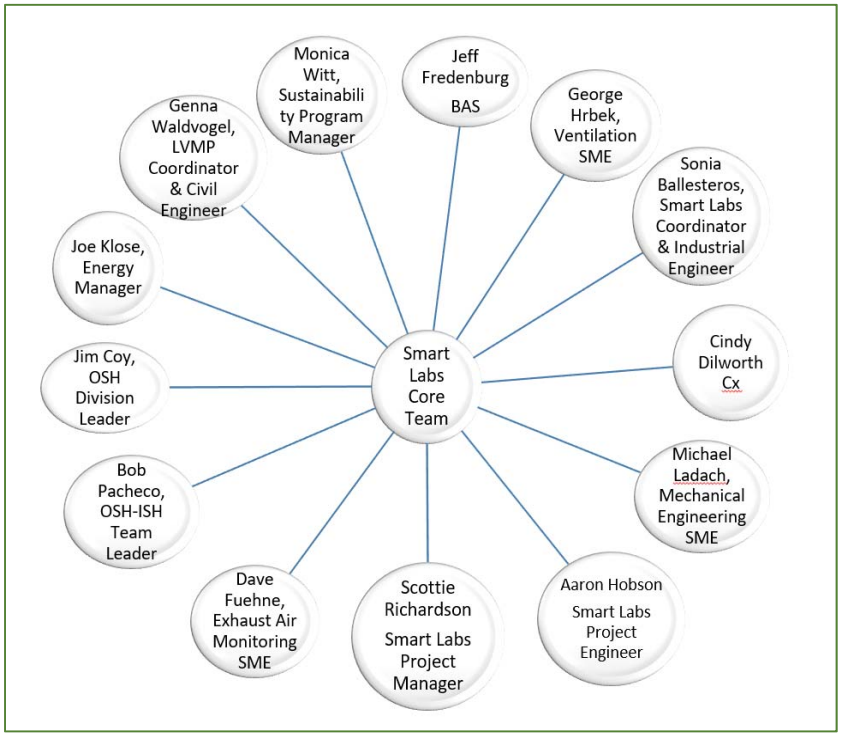
UC Irvine results

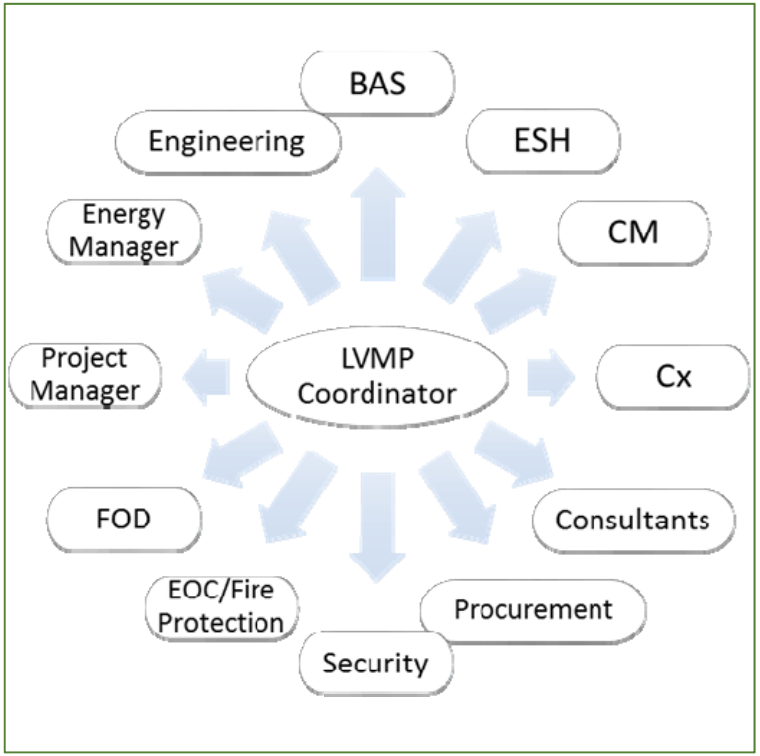
Laboratory Building		Before Smart Lab Retrofit			After Smart Lab Retrofit		
Name	Type*	Estimated Avg. ACH	VAV or CV	Was more efficient than code?	kWh Savings	Therm Savings	Total Savings
Croul Hall	P	6.6	VAV	~ 20%	41%	60%	55%
McGaugh Hall	B	9.4	CV	no	40%	66%	47%
Reines Hall	P	11.3	CV	no	70%	76%	72%
Natural Sciences 2	P, B	9.1	VAV	~ 20%	48%	62%	50%
Biological Sciences 3	B	9.0	VAV	~ 30%	45%	81%	60%
CALIT2	E	6.0	VAV	~ 20%	46%	78%	62%
Gillespie Neurosciences	M	6.8	CV	~ 20%	58%	81%	61%
Sprague Hall	M	7.2	VAV	~ 20%	58%	82%	71%
Hewitt Hall	M	8.7	VAV	~ 20%	58%	77%	69%
Engineering 3	E	8.0	VAV	~ 30%	59%	78%	61%
Averages	–	8.2	VAV	~ 20%	55%	76%	58%

*Key: P = physical sciences, B = biological sciences, E = engineering, M = medical sciences.

Established Smart Lab Core Team

- Common Goal:
  - Understand the potential of the Smart Labs
  - Get the organizational culture prepared to implement both the organizational component and the facility component of Smart Labs



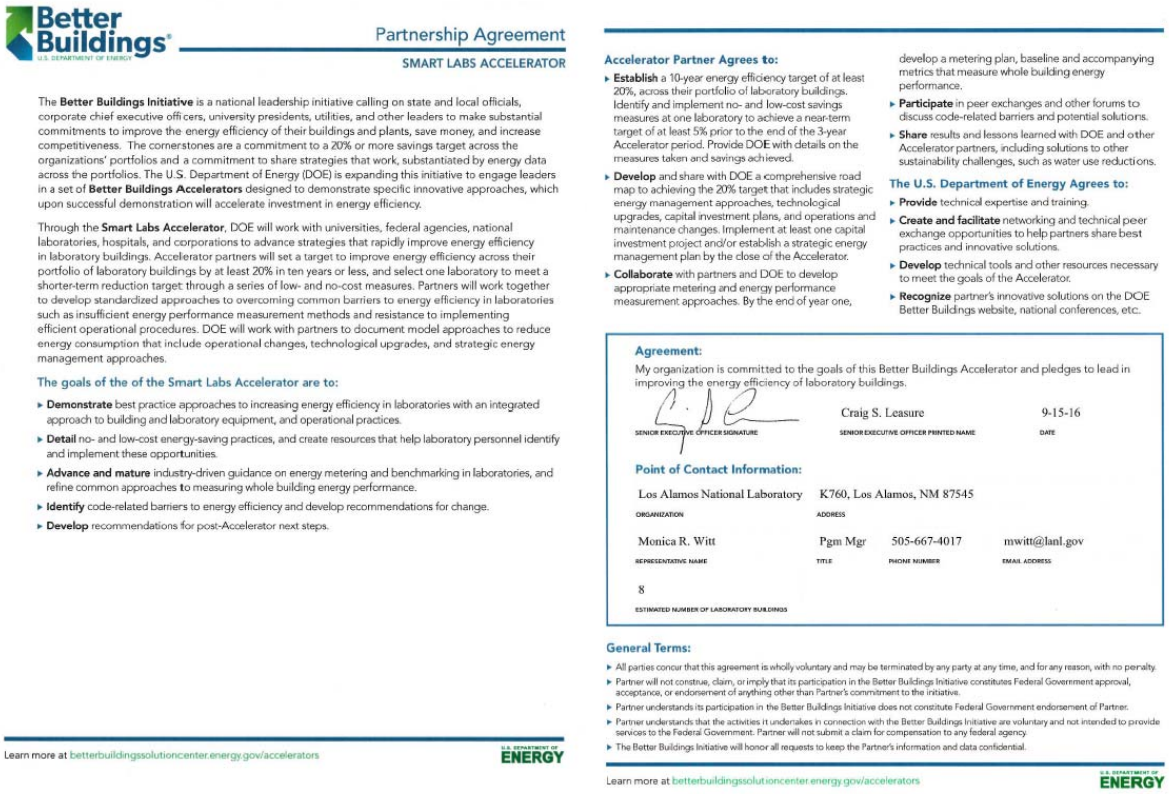


Management Attention

Risks – Implementing Smart Labs
Everybody will hate you (at the beginning). Nobody likes ***change!***
Funding not available. Takes a lot of time, money, and effort… can we afford this? "We're already over tasked!"
Staff not trained appropriately. If you put high tech equipment in a low tech operating environment, you will not meet full potential.

Risks – *NOT* Implementing Smart Labs
Attracting new talent will be a challenge.
Poor productivity
Equipment lifetime decreased
Insufficient lighting – safety issue
Uncontrollable temperatures for sensitive experiments
Fume hood down time unacceptably high

DOE Better Buildings Smart Lab Accelerator Program



Better Buildings
U.S. DEPARTMENT OF ENERGY

Partnership Agreement

SMART LABS ACCELERATOR

The **Better Buildings Initiative** is a national leadership initiative calling on state and local officials, corporate chief executive officers, university presidents, utilities, and other leaders to make substantial commitments to improve the energy efficiency of their buildings and plants, save money, and increase competitiveness. The cornerstones are a commitment to a 20% or more savings target across the organizations' portfolios and a commitment to share strategies that work, substantiated by energy data across the portfolios. The U.S. Department of Energy (DOE) is expanding this initiative to engage leaders in a set of **Better Buildings Accelerators** designed to demonstrate specific innovative approaches, which upon successful demonstration will accelerate investment in energy efficiency.

Through the **Smart Labs Accelerator**, DOE will work with universities, federal agencies, national laboratories, hospitals, and corporations to advance strategies that rapidly improve energy efficiency in laboratory buildings. Accelerator partners will set a target to improve energy efficiency across their portfolio of laboratory buildings by at least 20% in ten years or less, and select one laboratory to meet a shorter-term reduction target through a series of low- and no-cost measures. Partners will work together to develop standardized approaches to overcoming common barriers to energy efficiency in laboratories such as insufficient energy performance measurement methods and resistance to implementing efficient operational procedures. DOE will work with partners to document model approaches to reduce energy consumption that include operational changes, technological upgrades, and strategic energy management approaches.

The goals of the of the Smart Labs Accelerator are to:

- **Demonstrate** best practice approaches to increasing energy efficiency in laboratories with an integrated approach to building and laboratory equipment, and operational practices.
- **Detail** no- and low-cost energy-saving practices, and create resources that help laboratory personnel identify and implement these opportunities.
- **Advance and mature** industry-driven guidance on energy metering and benchmarking in laboratories, and refine common approaches to measuring whole building energy performance.
- **Identify** code-related barriers to energy efficiency and develop recommendations for change.
- **Develop** recommendations for post-Accelerator next steps.

Learn more at betterbuildingssolutioncenter.energy.gov/accelerators

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Accelerator Partner Agrees to:

- **Establish** a 10-year energy efficiency target of at least 20%, across their portfolio of laboratory buildings. Identify and implement no- and low-cost savings measures at one laboratory to achieve a near-term target of at least 5% prior to the end of the 3-year Accelerator period. Provide DOE with details on the measures taken and savings achieved.
- **Develop** and share with DOE a comprehensive road map to achieving the 20% target that includes strategic energy management approaches, technological upgrades, capital investment plans, and operations and maintenance changes. Implement at least one capital investment project and/or establish a strategic energy management plan by the close of the Accelerator.
- **Collaborate** with partners and DOE to develop appropriate metering and energy performance measurement approaches. By the end of year one, develop a metering plan, baseline and accompanying metrics that measure whole building energy performance.
- **Participate** in peer exchanges and other forums to discuss code-related barriers and potential solutions.
- **Share** results and lessons learned with DOE and other Accelerator partners, including solutions to other sustainability challenges, such as water use reductions.

The U.S. Department of Energy Agrees to:

- **Provide** technical expertise and training.
- **Create and facilitate** networking and technical peer exchange opportunities to help partners share best practices and innovative solutions.
- **Develop** technical tools and other resources necessary to meet the goals of the Accelerator.
- **Recognize** partner's innovative solutions on the DOE Better Buildings website, national conferences, etc.

Agreement:

My organization is committed to the goals of this Better Buildings Accelerator and pledges to lead in improving the energy efficiency of laboratory buildings.

Craig S. Leasure	9-15-16
SENIOR EXECUTIVE OFFICER SIGNATURE	SENIOR EXECUTIVE OFFICER PRINTED NAME / DATE

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REPRESENTATIVE NAME	TITLE	PHONE NUMBER	EMAIL ADDRESS
8			
ESTIMATED NUMBER OF LABORATORY BUILDINGS			

General Terms:

- All parties concur that this agreement is wholly voluntary and may be terminated by any party at any time, and for any reason, with no penalty.
- Partner will not construe, claim, or imply that its participation in the Better Buildings Initiative constitutes Federal Government approval, acceptance, or endorsement of anything other than Partner's commitment to the initiative.
- Partner understands its participation in the Better Buildings Initiative does not constitute Federal Government endorsement of Partner.
- Partner understands that the activities it undertakes in connection with the Better Buildings Initiative are voluntary and not intended to provide services to the Federal Government. Partner will not submit a claim for compensation to any federal agency.
- The Better Buildings Initiative will honor all requests to keep the Partner's information and data confidential.

Learn more at betterbuildingssolutioncenter.energy.gov/accelerators

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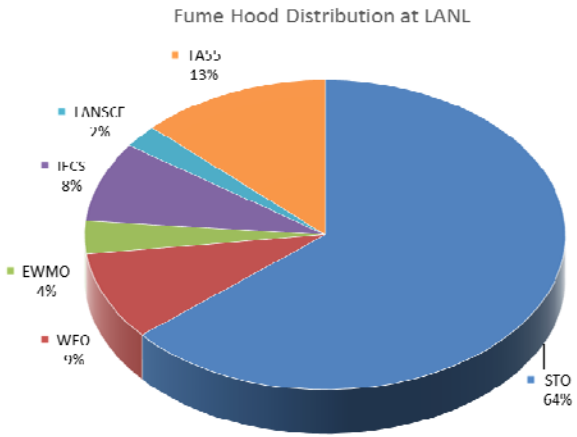
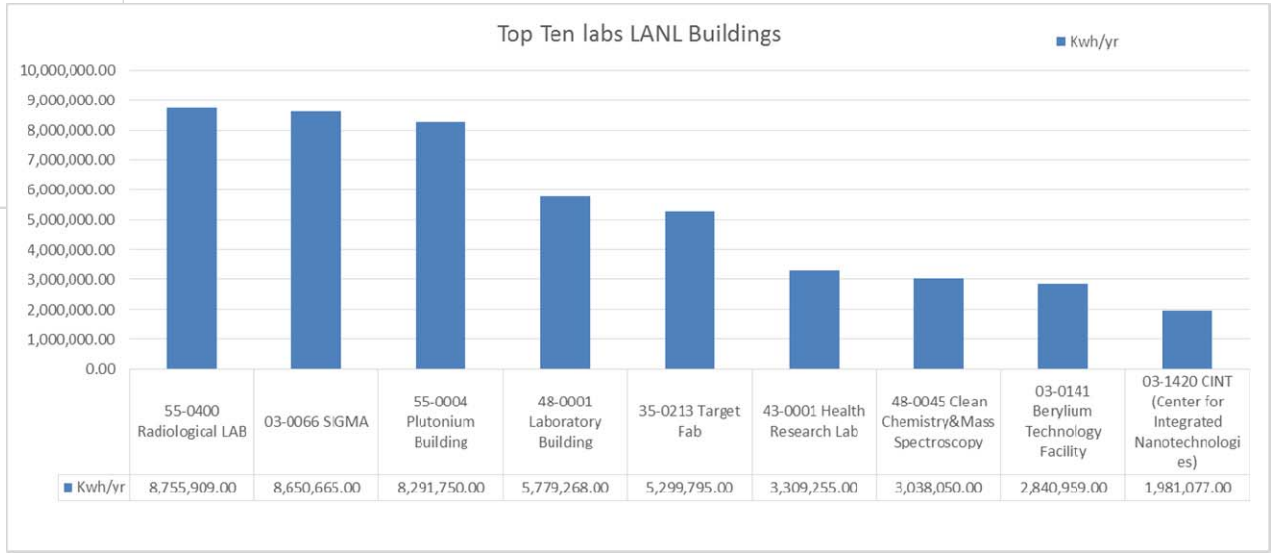
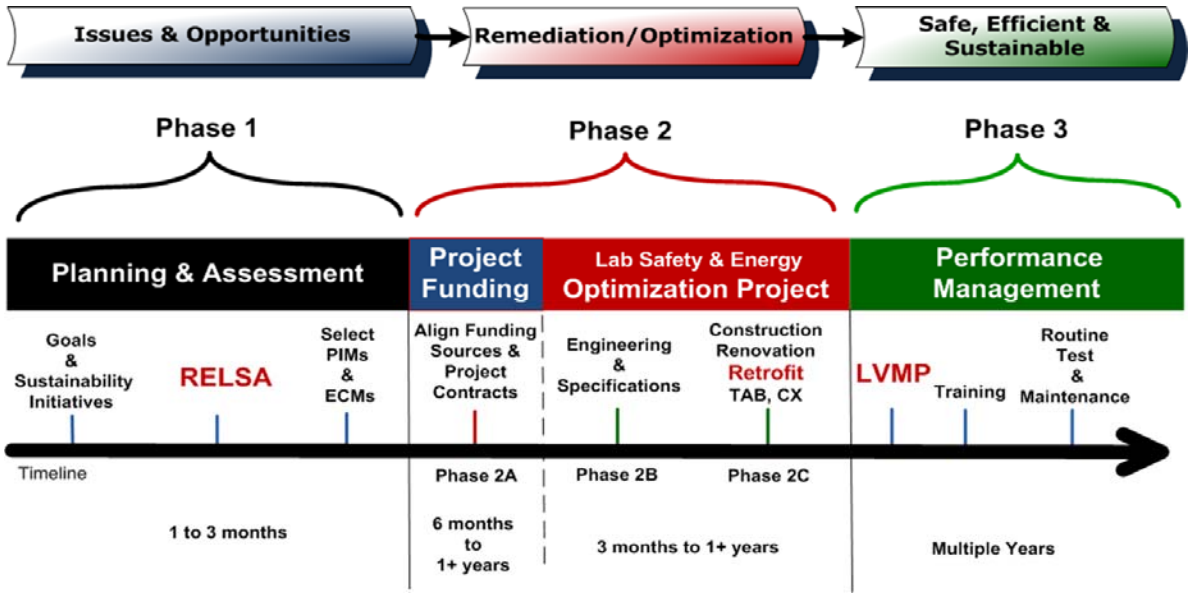
- Partnership agreement signed in September 2016
- target to improve energy efficiency by at least 20% in selected facilities
- Partners work together to develop standardized approaches to overcoming common barriers to energy efficiency in laboratories
- DOE works with partners to document model approaches to:
  - reduce energy consumption
  - Including operational changes and technological upgrades
  - Strategic energy management

Building Selection: First Cut





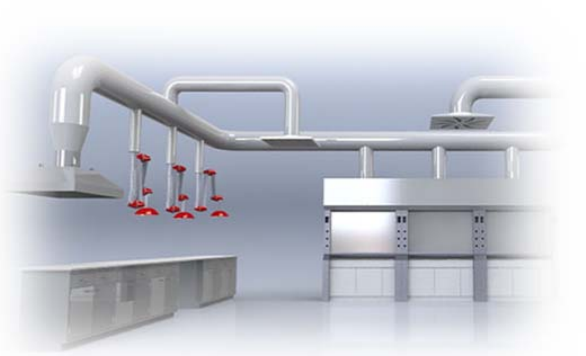
Follow the Road Map



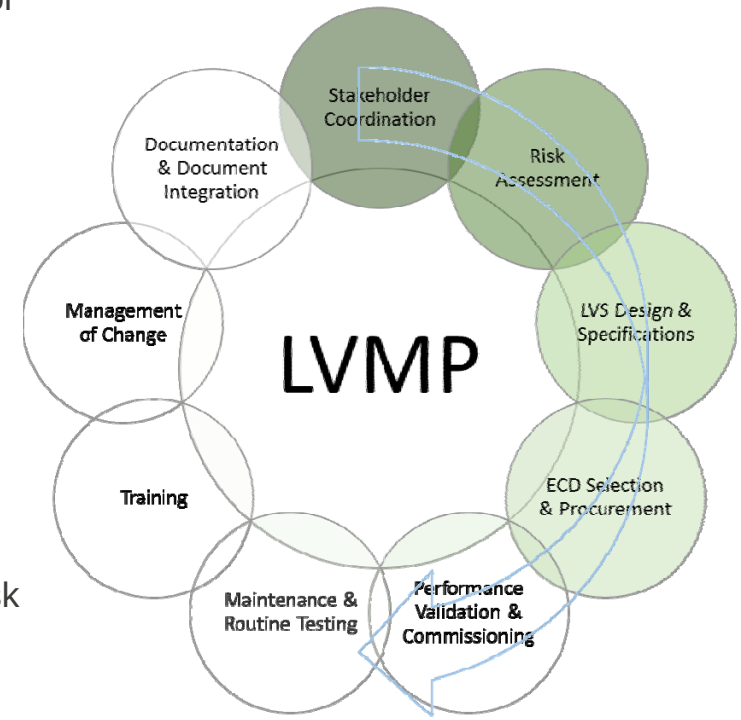
- **Phase 1:**
  - 1a. Top Ten High Energy Use Facilities
  - 1b. RELSA: Rapid Energy Laboratory Assessment in 8 facilities
  - 1c. Selection of the “best” four (4) facilities for “immediate” Smart Lab Implementation
  - 1d. DVA: Demand Ventilation Assessment in the four selected facilities to select PIMs and ECMs
- **Phase 2:**
  - 2a. Pilot Project: Selection of a pilot building for Smart Labs Implementation. Alignment of Funding Sources
  - 2b. Actual Status: Pilot Project Smart Lab design for implementation.
- **Phase 3:**
  - LVMP in process of implementation:
    - PM in process
    - Training
    - BMP in process

Laboratory Ventilation Management Plan

Laboratory Ventilation Management Plan



- Umbrella document
  - Defines scope, roles and responsibilities, and requirements for planning, design, construction, renovation, commissioning, maintenance and managing of laboratory exhaust ventilation for exposure control and associated heating ventilation, air conditioning and refrigeration systems
  - Applies to all existing, modified and new facilities that utilize laboratory exhaust ventilation systems for exposure control in LANL facilities
  - Cycle of activity: these activities or requirements, starting with stakeholder coordination, include risk assessment, system design, preventive and corrective maintenance, management of change, and documentation.



Laboratory Ventilation Management Program

- We created Roles and Responsibilities for all LVMP members and for all phases
- We have created communication between all team members, including laboratory tenants:
  - We have involved tenants with Status Update Board and Weekly meetings
- We had training: (ESH, IH, Maintenance, Cx, BAS)
  - LVRA
  - HVAC Systems and Laboratory Test Analysis
  - Building and Implementing a Performance Management Plan (PMP)
- We have developed:
  - Preventive Maintenance Plan
  - Hibernation Protocol
  - An Exposure Assessment with Risk Control Banding
  - Fume Hood Annual Certification Process Revisions (In process)
  - Fume Hood Database with connection to exhaust fans and all ID numbers being used (in process)
- Cerebro:
  - Safety net to align the different databases and make sure chemicals and ACH match the risk control band for the space
- We are tracking status for all buildings and metrics for all buildings

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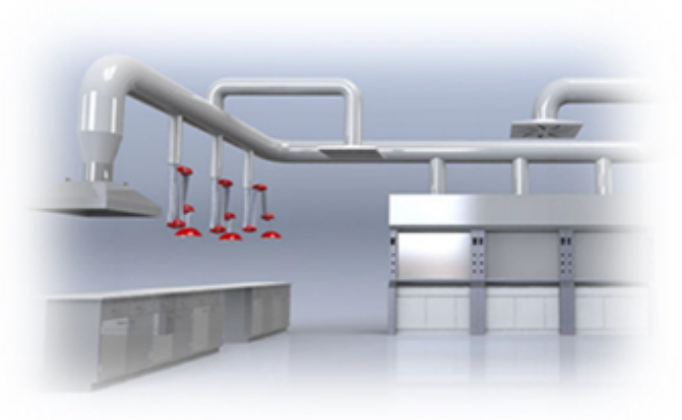
Laboratory Ventilation Management Program



Wind Tunnel Test

- **Objective:**
  - Develop a laboratory exhaust fan renovation strategy to reduce exhaust fan energy to the extent possible either by extending the stack height or slowing down exhaust speed

Track Progress

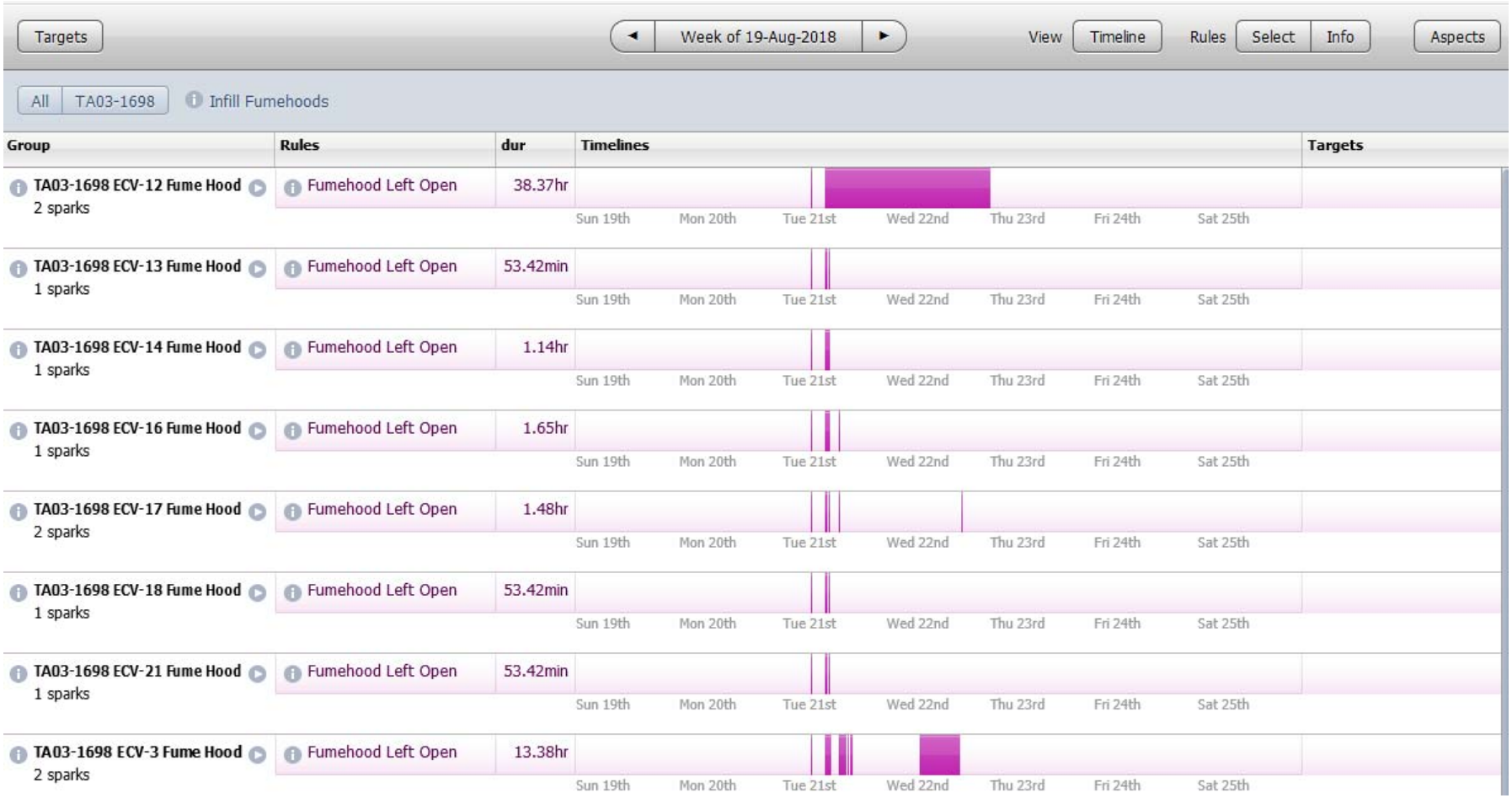
- 48-0107
- 03-1698:
  - Next Step: Benchmark operations and BMP
- 35-0085
  - Pilot Building
  - Controls Design In Process
  - Next Step: Design Implementation
- 48-0001:
  - Large RCx projects repairs
- 35-0213
  - BAS implementation
  - Large RCx project repairs
  - RCD for Smart Labs design and Implementation

	Phase 1A - Plan						Phase 1B - Assessment								Phase 2 Optimization						Phase 3 Manage					
	Qualitative Scoping Study					Contracting	Quantitative Performance Audit							Contracting	Construction / Renovation / Upgrade Project					Contracting	Performance Management and Operations Plan					
	1A-A	1A-B	1A-C	1A-D	Deliverable		1B-A	1B-B	1B-C	1B-D	1B-E	1B-F	Deliverable		2-A	2-B	2-C	2-D	Deliverable		3-A	3-B	3-C	3-D	3-E	Deliverable
Building Name	Team & LVMP Program Development	Building Systems Survey & Inventory	Systems Condition Status Indicators	Appraise & Profile Buildings	Building Project Priority Plan	Funding, Bids, Contracts	Building Systems Documents	LVRA	System Operating Tests	Airflow & Operating Specifications	Energy and Operating Cost Model	Performance Improvement Measures (PIMs)	Scope of Work for Optimization	Funding, Bids, Contracts	Engineering & Specifications	Implement PIMs	TAB & CX	Benchmark Operation	Building Management Plan (BMP)	Funding, Bids, Contracts	Implement BMP Train Personnel	BAS Monitoring Analytics	Maintenance and Functional Tests	Lab Safety Surveys	Change Management	Performance Status Reports
03-1698	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes									
35-0085	Yes	Yes	Yes	Yes	Yes		Yes, but dated	Yes	Yes	Yes	Yes	Yes	Yes													
48-0001	Yes	Yes	Yes	Yes	Yes		Yes, but dated	Yes	Yes	Yes	Yes	Yes	Yes													
35-0213	Yes	Yes	Yes	Yes	Yes		Yes, but dated	Yes	Yes	Yes	Yes	Yes	Yes													
48-0107	Yes	Yes	Yes	Yes	Yes		Yes		Yes	Yes		Yes			Yes	Yes	Yes	Yes								

FY18 Accomplishments – 03-1698 MSL

- *Installed sash stickers, a social engineered control, to remind users to lower their sashes*
- *Added SkySpark to all fume hoods – now we can track sash heights*
- *In process of obtaining occupancy sensors, to further explore connection between sash heights and occupancy*
- *Collaborated with tenants to hold ECT in Lab Training in infill area of MSL*

FY18 Accomplishments – 03-1698 MSL

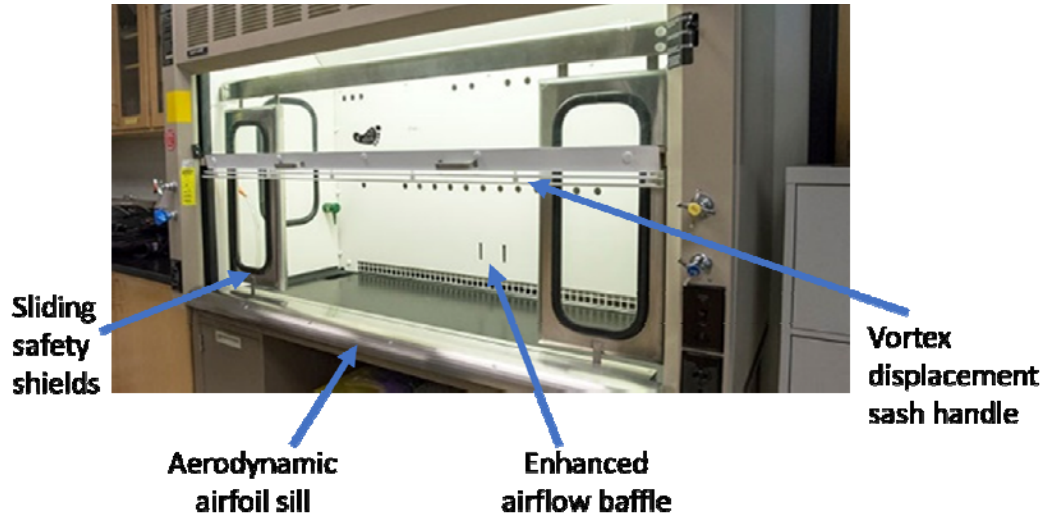


FY18 Accomplishments – TA-35-85

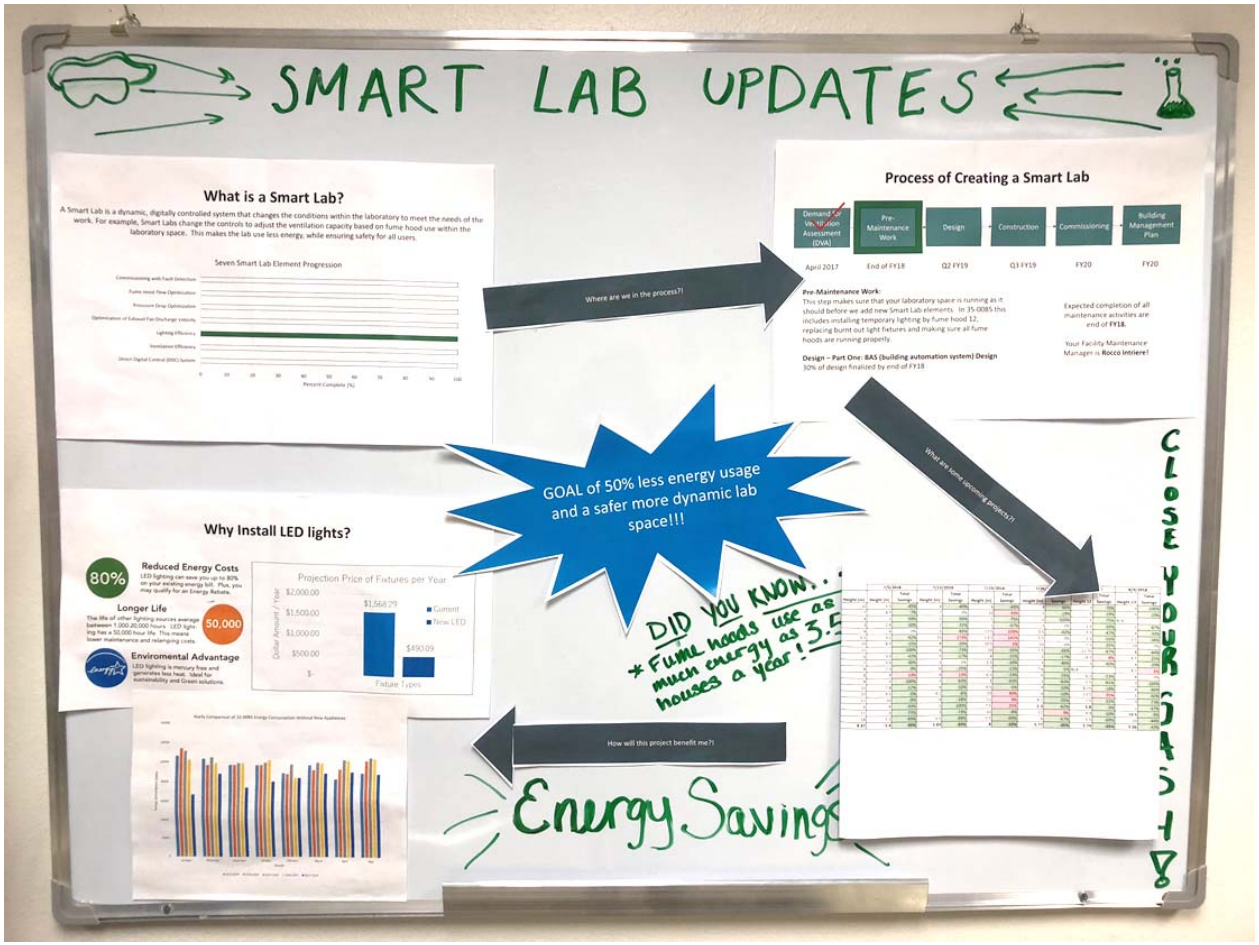
- *Great communication with tenants*
- *Installed sash stickers*
- *Installed all new LED lighting and added lighting in dark spaces for increased safety*
- *Completed preliminary BAS design for exhaust system (construct in FY19)*
- *Installing fume hood retrofit kits in four hoods (FY19)*
- *RCD completed for secondary BAS*

design for rest of HVAC system (FY19)

- *My Green Lab Criteria in progress*



TA 35-85 Smart Lab Communication Board



FY18 Accomplishments – TA-48-0001

- *Completed initial re-commissioning survey.*
- *Conducted Smart Labs survey of individual laboratories and reported risk assessment for each.*
- *Agreed, with stakeholders, on the scope of the first phase, a Life Extension project for the building's basic infrastructure*
- *Obtained estimates for this first phase - Switchgear, HVAC, and new Exhaust Ductwork ($16M)*
- *Presented to IS for funding beginning in FY '19, awaiting response.*

FY18 Accomplishments – Target Fabrication

- *Completed construction on Phase IA, installation of BAS backbone and controlling & modifying two air handlers.*

- *Completed construction on Phase IB, installation of controls on central equipment – pumps, boilers, etc. – as well as upgrades on these.*

- *Completed design and began project development on Phase II, chiller plant replacement, including purchase of chiller.*

FY18 Accomplishments – TA-48-107

- *Great communication with tenants*
- *Determined 'missing' Smart Lab Components, cost to install and ROI*
- *Installed sash stickers*
- *Created a Building Management Plan, which informs maintenance and tenants of the equipment and systems in the building*

Table 1. Estimated time, cost, and savings estimate comparison

Cost Description	Estimated Cost	Estimated Savings
Sash Stickers Installation	$ 100.00	$ 10,400.00
Manifolded Exhaust Stacks and Balance of Ventilation System:	$ 157,500.00	$ 15,153.18
Automated Time/ Motion sensors for Lighting	$ 1,000.00	$ 946.08
Estimated Totals:	**$ 158,600.00**	**$ 26,499.26**
Estimated Payoff Time:	**~6 years**	

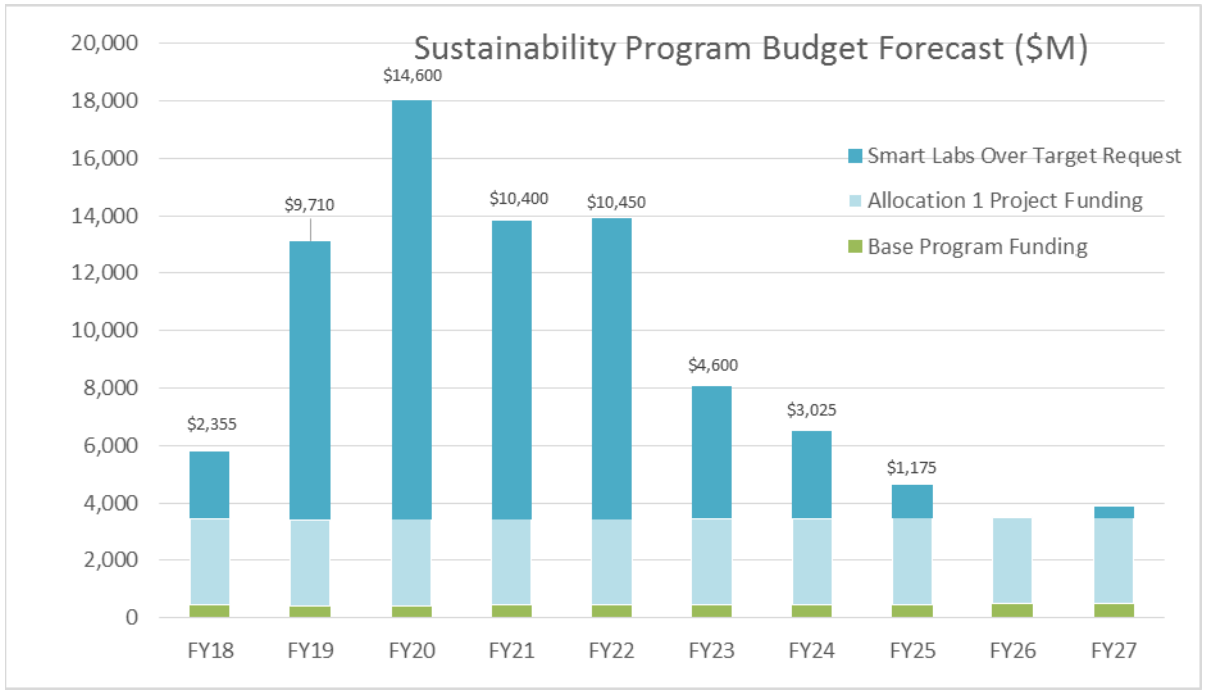
ROI for Smart Lab Upgrades

Metrics to Measure Success

- **Compared to a Baseline Year:**
  - Thermal and Electric Energy (BTU)
  - Average cfm/sqf
  - Source Energy Intensity (BTU/sqf)

	BASELINE YEAR	IF YES FY16 ELECTRIC (BTU)	THERMAL (BTU)	TOTAL SQF	TOTAL LAB SQF	Average cfm/sqf
03-1698	2016	4,540,000,000	see notes	71,772	28,707	0.52
35-0213	2016	16,920,000,000	see notes	84,818	27,990	1.52
35-0085	2016	4,350,000,000	see notes	26,119	9,637	0.90
48-0001	2015	17,194,000,000	27,000,000	105,836	50,801	Unknown

Future Funding & Projects



- **Smart Labs requires additional funding**
- **Facilities, such as TA-48-1 need MAJOR investments to continue to operate – Life Extension Projects**
- **Improved operations and energy efficiency… going to take investments to recognize the potential of Smart Labs**

Questions?

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